Engineering Analysis of EDR Data in NHTSA's NASS CDS Database

Marco daSilva
Office of Surface Transportation Programs
Advanced Safety Technology Division

2007 GOVERNMENT / INDUSTRY MEETING

May 14 -16, 2007 • L'Enfant Plaza Hotel • Washington DC, USA

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Objectives

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- Acquire existing EDR data gathered by NHTSA and construct an analysis database
- Perform comprehensive engineering analysis of EDR data to assess their accuracy and usefulness in crash reconstruction and improvement of vehicle safety systems

Background

- NHTSA has incorporated EDR data collection in three motor vehicle research databases (NASS-CDS, SCI, and CIREN).

- Virginia Tech (Volpe Center) developed an analysis database containing valid EDR downloads mostly from 2000-2005
  - Database contains 2,543 EDR files (2,464 GM, 79 Ford)

- Preliminary results of analyses of the EDR data in the 2000-2005 NASS-CDS database are presented herein (2,283 EDR files (90%) – all GM)

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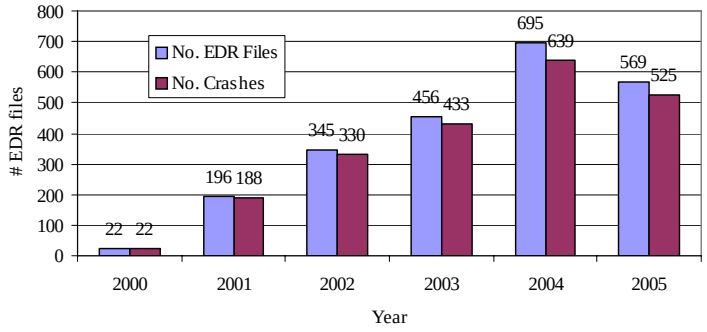
NASS-CDS EDR Data

- EDR Data Analysis
  - 2,283 EDR files
  - 2,137 crash cases (141 crashes contained multiple EDRs)



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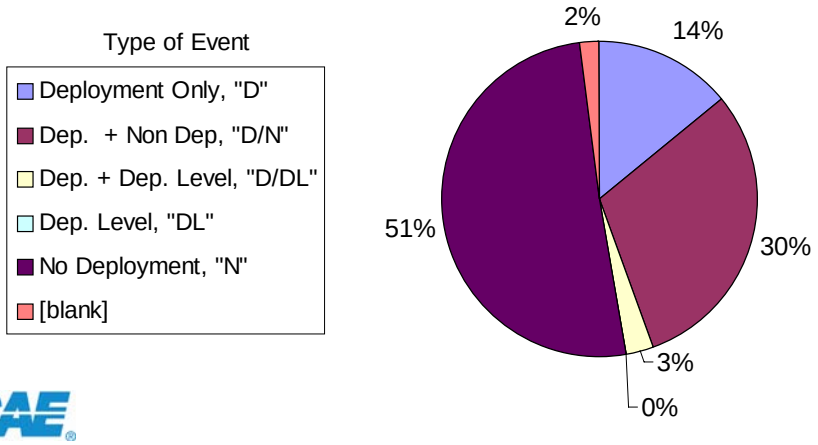
NASS-CDS EDR Data

- EDR Event Type
  - 2,240 EDR files contained an event “D”, “D/N”, “D/DL”, or “N”



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Event Type Breakdown

- EDR variables – reported values
  - 2,240 EDR files contained an event “D”, “D/N”, “D/DL”, or “N”

Pre-Crash	
EDR Variable	**% Reported**
Speed	55%
RPM	55%
Throttle %	55%
Brake Status	55%

Crash	
EDR Variable	**% Reported**
CDR Module Name	100%
Warning Lamp Status	100%
Seat Belt Status	100%
Seat Belt Status (RF Passenger)	2%
Paxssenger Airbag Suppression	74%
Ignition cycles at deployment	100%
Ignition cycles at investigation	73%
Time to 1st stage deployment	30%
EDR Maximum Recorded Delta V	68%
Time from Alg enable to max V change	53%
Delta V information up to 150 ms	84%
Delta V information up to 300 ms	32%

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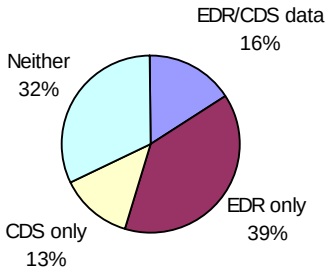
Pre-crash Data

- Travel Speed information (NASS CDS "Police Reported Travel Speed")

		CDS		
		Reported	**Not Reported**	**Total**
EDR	**Reported**	16%	38%	54%
	Not Reported	13%	32%	46%
	Total	29%	71%	100%



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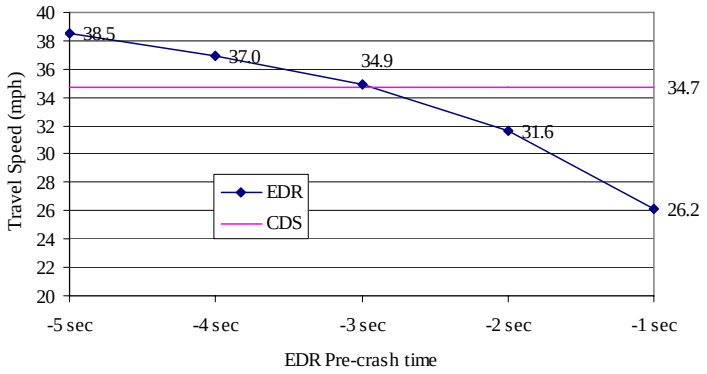
Pre-crash Data

- Travel Speed information (average) – Comparison of values where travel speed known (369 files)



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Pre-crash Data

- Travel Speed information – Comparison of values for cases where there is a “Brake Status” change from “OFF” to “ON” in the EDR files (243 cases)

  CDS Travel Speed avg = 39.3 mph

  EDR Travel Speed avg (at last Brake Status = OFF) = 42.0 mph (+6.9%)

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Pre-crash Data

- Brake Status information (NASS CDS “Attempted Avoidance Maneuver”)

EDR data at -1sec		CDS* Includes Braking	CDS* No Avoid. Action	CDS* Other	Total	% of Total
EDR	Brake=OFF	77	229	200	506	22%
	Brake=ON	209	236	269	714	31%
	Brake=Invalid	4	3	4	11	0%
	Brake=[blank]	238	429	385	1,052	46%
Total		528	897	858	2,283	
% of Total		23%	39%	38%		

*Includes Braking = CDS codes 2, 3, 4, 8, and 9
*No Avoid. Action = CDS code 1
*other = CDS code -, 5, 6, 7, 10, 11, 12, 98, 99, 0

- Pre-crash braking is denoted in 31% of EDR files and 23% of CDS files
- 209 cases where both CDS and EDR files denote braking (9.1%)
- 236 cases where EDR files denote braking but CDS files reported no avoidance action (10.3%)

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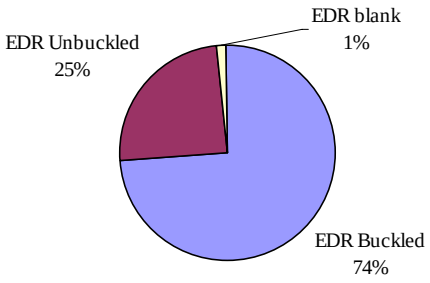
Post-Crash Data

- Driver seatbelt use information (NASS CDS "Manual (Active) Belt System Use" - 2,059 CDS vehicle files have occupant information)

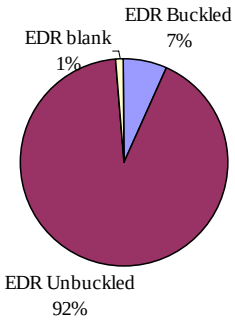
CDS Buckled

(1,650 files)



CDS Unbuckled

(409 files)



Post-Crash Data

- Driver airbag deployment information (NASS CDS "Frontal Air Bag System Deployment")

		CDS Frontal Air Bag System Deployment				
		Deployed	Nondeployed	Other	Total	% of Total
EDR	Deployed	1,027	30	21	1,078	47.2%
	Nondeployed	15	968	180	1,163	50.9%
	[blank]	-	27	15	42	1.8%
Total		1,042	1,025	216	2,283	
% of Total		45.6%	44.9%	9.5%		

• Unknown whether air bag deployed in almost 10% of CDS cases (only in about 2% of EDR files)

Post-Crash Data

- Delta V information (NASS CDS "Total Delta V")

		CDS		
		Reported	Not Reported	Total
EDR	Reported	56%	27%	83%
	Not Reported	10%	7%	17%
	Total	66%	34%	100%

1,270 cases in which Delta V is reported for both EDR and CDS vehicle files. However, most EDRs only record longitudinal Delta V

Post-Crash Data

478 frontal impact cases in which Delta V is known for both EDR and CDS vehicle files (frontal impact: PDOF1 = 0, 10, 350)

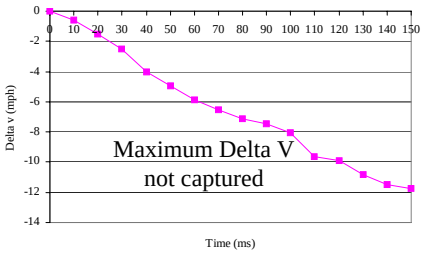
CDS Coded PDOF1 (deg.)	# Cases	EDR Avg time to max DeltaV (ms)	EDR Avg DeltaV (mph)	CDS Avg DVLONG (mph)	Avg DeltaV difference (mph)	% difference
0	209	131.4	-16.7	-16.8	0.1	-0.7%
10	126	129.8	-16.6	-15.6	-1.0	6.5%
350	143	121.8	-16.0	-15.1	-0.8	5.5%
0, 10, 350	478	128.1	-16.4	-16.0	-0.5	2.9%

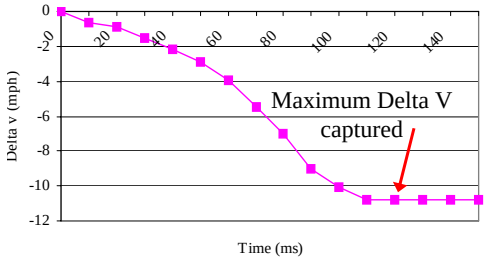
EDR deltaV Recording Capability (478 GM EDR files - '00-'05 NASS/CDS)

- 150ms EDRs: full crash pulse captured in 89% of cases
- 300ms EDRs: full crash pulse captured in 98% of cases

Post-Crash Data

- Crash Pulse Examples





238 frontal impact cases in which Delta V is known for EDR file only (frontal impact: PDOF1 = 0, 10, 350)

Using the EDR Delta V information from these EDR files to augment the CDS files would result in an increase of 10% of Delta V coding (1,502+238=1740, 76% of 2,283)

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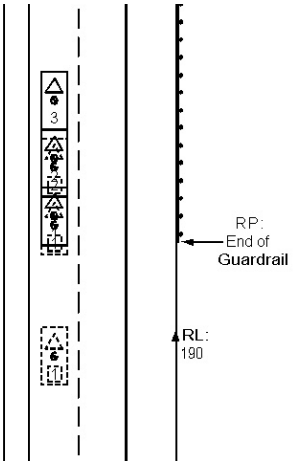
Sample Vehicle Case

Case #2004-008-207 (CaseId: 152007723)

NASS vehicle no. 1 – 2000 Chevrolet Cavalier

Summary excerpt: "V1 was approaching V2 when the front of V1 struck the back of V2 pushing the front of V2 into the back of V3."



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Sample Vehicle Case

Case #2004-008-207 (CaseId: 152007723)

NASS vehicle no. 1 – 2000 Chevrolet Cavalier (CDR module SDMG2000)

CDS data

Travel Speed: 65 mph

Critical Precrash Event: "Traveling same way decelerating"

Avoidance Maneuver: "No Avoidance Maneuver"

Driver seatbelt: "lap and shoulder belt"

Frontal Air Bag System Deployment:
"Air Bag Deployed During Crash"

Delta V: -11.18 mph
(basis for Delta V: SMASH – Damage only)

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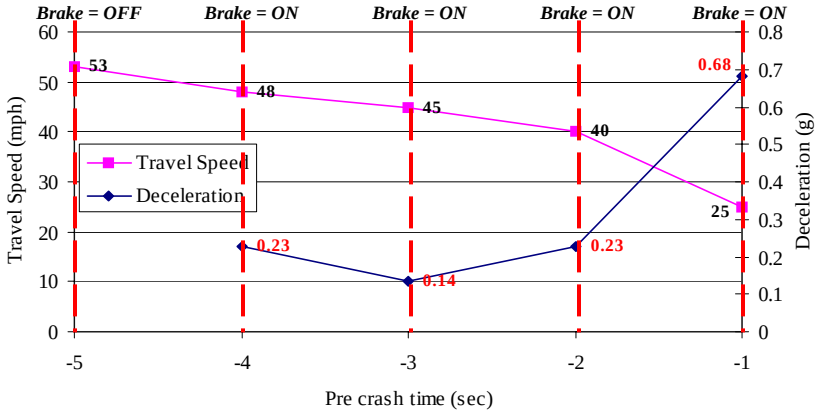
Sample Vehicle Case

Case #2004-008-207 (CaseId: 152007723)

NASS vehicle no. 1 – 2000 Chevrolet Cavalier (CDR module SDMG2000)

EDR Precrash data



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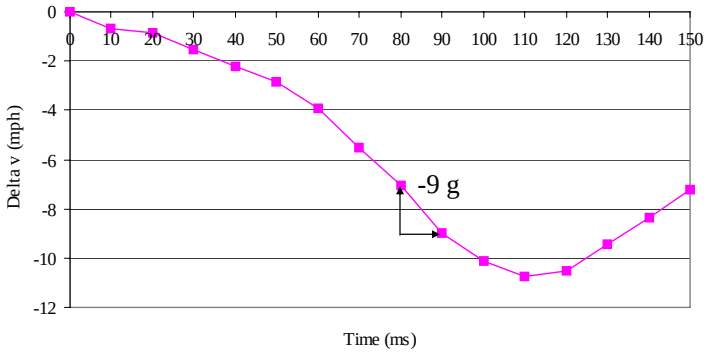
Sample Vehicle Case

Case #2004-008-207 (CaseId: 152007723)

NASS vehicle no. 1 – 2000 Chevrolet Cavalier (CDR module SDMG2000)

EDR Delta V pulse: maximum at 110ms (-10.8 mph,
4% less than CDS estimate of -11.2 mph)



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Final Thoughts

- Present-day EDR can provide useful information to:
  - replaced/validate estimated and unknown values in CDS (travel speed, seatbelt use, Delta V…)
  - augment data in CDS (air bag deployment time, 2nd stage deployments, emergency braking levels, reaction time, crash pulse acceleration…)
- Analysis in ongoing and Final Report expected later this year

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Questions/Comments?

Marco daSilva

General Engineer

U.S. DOT/Volpe Center
Office of Surface Transportation Programs
Advanced Safety Technology Division, RTV-3F
55 Broadway
Cambridge, MA 02142
dasilvam@volpe.dot.gov
(617) 494-2246

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